Waste Management and Asset Service Improvement in Pematangsiantar

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Abstract
Technical analysis of operational waste management assets includes containers, collection and transport, whereas the financial research and analysis of the feasibility of using Net Present Value, Internal Rate of Return, Benefit/Cost Ratio, and Payback Period. Waste management in Pematangsiantar still resting on final approach (get-together waste transport) with a low level of service. This research aims to examine waste management system. From the analysis, it was found that a waste management with a sorting method in the polling stations based on services zone priority gradually increasing from 2011-2015, can improve the coverage of existing garbage service average 11.34%, coverage of existing TPS services an average of 1.74%, and the scope of service of existing garbage transport trucks average 16,23%. Asset investment costs in 2011, assuming the value of depreciation or depreciation of assets used TPS until age 20 where the cost of equipment, operating costs and maintenance costs are assumed to rise ± 10% each year.
Keywords: Waste, Asset Service, Pematangsiantar, Management, PP TPS.

1. Background

According to the Department of Sanitary Pematangsiantar, the waste management is still based on final approach; the garbage is collected, transported, and disposed of in landfills (TPA), with the coverage about 20% of the total area of Pematangsiantar. Waste management is handled by Division of Sanitary, Parks and Cemeteries, Department of Sanitary Pematangsiantar, while the waste management activities carried out by the Health Services Section.

The asset of waste management is 27 units of $3m^3$ capacity concrete polling station (TPS), 18 units of $3m^3$ capacity knock down, and 9 units of $6m^3$ capacity containers. Waste transported by using 27 vehicles; 18 units of dump trucks and 9 units of $6m^3$ capacity armroll trucks. For final processing, there are two polling stations, namely TPS **Tanjungpinggir1** of 2.5 ha (already used about 90%) and TPS **Tanjungpinggir2** of 5 ha, (not yet operating). The waste disposal method in the TPA by means of open dumping [3,5,7,9].

The waste management budget in 2013 only 0.76% of the total budget, while the revenue from waste retribution only 99,24% of the total budget of waste management.

In improving waste management, a service strategy is required to increase the capacity of waste handling. For that is necessary to study a waste management system with a sorting method at the polling stations in order to improve the coverage of the asset until 2015 both technically operational and financial aspects [6,8,10].

2. Methodology

This study is a descriptive study. The location is the area of waste management services Tanjungpinggir. The data collected are qualitative and quantitative, which includes the characteristics of the region, administration, population, socioeconomic, waste piles, waste composition, local services, asset management and financing of waste management [1,3,5,7,9].

The data were analyzed descriptively, which describes the condition of the existing technical, operational and financing of waste management assets. Primary data and secondary data were then compared with the standard NSPM in order to obtain a general overview of waste management in Pematangsiantar. The analysis of technical operation and feasibility using the investment criteria of Net Present Value, Internal Rate of Return, Benefit/Cost Ratio, and Payback Period [2,4,6,8,10].

3. Findings and Discussion
3.1 Technical Operations of Waste Management Asset
3.1.1. Waste piles

The average of household waste density is 0,49 kg/person/day. The average of piles that generated is equal to 0.50 1/person/day or the equivalent of 2.50 kg/person/day (table 1). A total of one day pile generated in Pematangsiantar in 2011 with a population of 234.698 is about 434,35 m^3/day [4,6,8].

According to SNI (1995), a waste pile to a small town with a population of < 100,000 of 2.5 1/person/day, equivalent to 0.7 kg/person/day, and the city with the population between 100,000 – 500,000 of 3.00 1/person/day, equivalent to 0.8 kg/person/day. While the waste pile in Pematangsiantar with the population > 2 million of 2.50 1/person/day, equivalent to 0.45 kg/person/day [2,6,10].

3.1.2. Composition

Most compositions are leftovers and foliage 80,73%, plastic 8,52%, paper 6,00%, fabric 0,20%, metal 0,25%, glasses 0.30% and the other of 4.96%. Compared to Astari (2010), in Wonocolo, Surabaya, there are similar composition, which is largely dominated by wet waste in the form of leftovers and foliage 80,73%, plastic 8,52%, paper 6,10% and another 5.25% (metal, glasses, wood, cloth, rubber, etc.) [1,3,5,7].

3.1.3. Container

Based on the SNI (2002), there are some requirements of material, such as not easily damaged and water-resistant, economical and easy to obtain and emptied. While the characteristics of individual and communal waste container are:

1. Box-shaped, cylinder, container, bin (barrel), and is covered.
2. Light, easily moved and easily emptied.
3. Various metals, plastics, fiberglass (GRP), wood, bamboo, rattan.

At this moment there is no separation between the organic and anorganic waste container. Most of the public waste container is plastic bags, trash bin, bamboo baskets, sacks and brick container.

For communal containers, in some locations such as main streets and in residential areas, a polling station (TPS) is built of concrete and container. Communal containers generally do not have a cover so it is easily disturbed by animals and trash strewn around the TPS, causing odors and disrupt the aesthetic environment.

3.1.4. Waste collection
1) Residential waste
   The method of residential waste collection:
   a) Indirect individual: The officers went to the source of the waste using a flotation device such as a motor and trash carts.
   b) Indirect communal: This pattern applies to crowded residential areas, narrow alleys and cannot be passed by collection vehicles.
   c) Direct individual: Conducted door to door using a dump truck in a residential area along the transport path.
2) Nonresidential waste
   For office/school areas, trash collected by the clerk to be taken to the nearest polling station, while for hospitals and supermarkets/malls, garbage collection is done specifically on the provided containers. The waste collection in the market area carried out by market cleaners, whereas for sweeping, particularly directed at the main streets, sidewalks, parks and other public places. Waste is collected at the nearest polling station and then transported to the TPA.

3.1.5. Transportation
Waste transportation is using two types of vehicles, dump-truck and armroll-truck. Dump truck 27 units (67% 3-7 years old, and 26% between 8-20 years old); and armroll truck 12 units (50% 3-5 years old and 50% between 9-14 years).

According to the provisions of the Department of Public Works (2009), technical life-use of litter vehicles is 7 years. Due to this condition, the requirement for dump truck replacement year of 2011 14 units, year of 2012 1 unit, year of 2013 7 units, year of 2014 3 units, and 4 units in year of 2015. While armroll truck replacement in year of 2011 16 units, year of 2013 3 units, and 3 units in year of 2015.

Waste hauling only 2 trips per day due to the distance to the TPA. Based on the provisions of the Department of Public Works (2009), the minimum trip of dump truck per day is 3 with a maximum crew of 3, whereas armroll truck is 1 [3,5,7].

The trip carriage can still be improved, but there is no clerk who recorded the time of arrival and return at TPA sites and the lack of weighbridge to determine the weight of waste transported and the amount of garbage that has piled up in the TPA [2,4,6].

3.2. Waste Management Assets Budgetting
Compared to regional budget of Pematangsiantar 2013, waste management budget in 2013 was very low at ± 076% of the total budget. Then, if the revenue of retribution compared to waste management budget in the 2013, 99,91% comes from the regional budget and 0,09% from retribution.

According to the Department of Housing and Infrastructure (2003), budgeting of waste management should receive equal priority with the management of other public services (ranging from 10% local government, regional budget), budgetary resources from the public waste management costs by 70% and 30% of government. The budget of waste management and realization of revenue should be increased as not in accordance with established standards [2,4,6].

3.3. Level of Existing Waste Service
If the total volume compared with the pile transported to the TPA, the existing service level of waste management in 2011 is at 35,24% [1,2,3].
Referring to the Minimum Service Standards (of SPM) Division of Public Works and Spatial Planning in 2014, the target of waste management in urban areas is 70%. This means that the service level provided by the government is very low, and there are 64,76% waste transportation unserved [2,4,6].

3.4. Level of Existing Assets Service
3.4.1. Level of Existing TPS Service
If the total capacity of the existing TPS compared to the projection of handling piles, the TPS existing service levels in 2011 of 35,24%, 25,31% in 2012, 23,14% in 2013, 22,25% in 2014, and continually dropped to 59,67% in 2015, with 25,07 % of average annual decline (Table 3). An asset additions program is required to improve service levels to overcome this reduction [4,6,8].

3.4.2. Level of Existing Trucks Service
If the total capacity of trucks compared to the projections of handling piles per day, the service level of existing trucks in 2011 of 74.53%, 67,78% in 2012 61,95% in 2013, 59,67% in 2014, continued to fall to 59,95% in 2015, with an average annual decline of 51,89% (Table 4). Program asset additions of vehicles are required to improve service levels [1,2,3].

3.5. Waste Management with Sorting method
Regional Technical Implementation Unit (UPTD) Cipta Karya Pematangsiantar divides the waste management service area into five zones (Figure 6). Sorting method was implemented through annual priorities based on service area [2,4].
To determine the sorting of waste management in the TPS, it is necessary to determine the amount of waste can be reduced and residual piles discarded to TPA per service zone by multiplying the percentage composition of the waste with waste management recovery factor (Tables 5 and 6).
The level of waste management services with sorting in the TPS can be illustrated as in Figure 7-11. Based on the illustration, the gradual separation in the TPS per year per zone will increase the services in 2011 about 22,64% with sorting only in zone I 1,70% in 2012 with sorting in zone I and III; 1,75% in 2013 with sorting in zone I, II and III; 3,12% in 2014 with sorting in zone I, II, III and IV; and an increase of 1.65% in 2015 with sorting in zone I, II, III, IV and V, with the average increase of 6.69% (Table 7).

3.6. Level of Existing Assets Service with Sorting method in TPS
3.6.1. Level of Existing TPS Service

With a gradual sorting method per service zone, there will be a decrease of service level in 2011 about 12,64 % by sorting only the first zone 31,38% in 2012 with sorting in zone I and III 16,22% in 2013 with sorting in zone I, II and III, 2,75% in 2014 with sorting in zone I, II, III and IV; and 11,34% in 2015 with sorting in zone I, II, III, IV and V, with the average decrease of 1,74% (Table 8).

3.6.2. Level of Existing Truck Services

Based on the remaining piles are disposed to TPA, sorting and gradual improvement of existing transport service, there will be service improvement in 2011 amounted to 6,78% by sorting only in first zone; 46,40% in 2012 with sorting in zone I and III; 14,04% in 2013 with sorting in zone I, II and III; 6,99% in 2014 with sorting in zone I, II, III and IV; and 12.95% in 2015 with sorting in zone I, II, III, IV and V, with the average improvement of 12.03% (Table 9).

3.7. Waste Service Improvement with Sorting method in TPS

Based on the projected level of waste management services through gradual sorting in the TPS per service zone until 2015, there will be service improvement in 2011 amounted to 8,29%, 15,74% in 2012, 24,87% in 2013, 3.12% in 2014, and 1.65% in 2015, with the average improvement of 6.69% (Table 10).

3.8. Existing Assets Improvement with Sorting method in TPS
3.8.1. Existing TPS Service Improvement

Based on the projection of waste management service per zone until 2015, there will be improvement of existing TPS service or lowering the decline level of existing services of TPS in 2011 amounted to 12,60%, 31,38 in 2012, 4.00% in 2013, 2,75% in 2014, and 1,74% in 2015, with the average improvement of 8.29% (Table 11).

3.8.2. Existing Truck Services Improvement

Based on the projection of waste management service per zone until 2015, there will be improvement of existing truck services in 2011 amounted to 6.78%, 9.58% in 2012, 16.18% in 2013, 14.64% in 2014, and 25,47% in 2015, with the average improvement of 8,26% (Table 11).

3.9. Feasibility Analysis
   Feasibility analysis using the following assumptions:
   1) The polling station is required as temporary dump;
   2) It takes at least 1 container in each polling station as a trash container that cannot be reduced/residual waste;
   3) The armroll truck is required as a waste carrier vehicle;
   4) It requires 2 freelance workers in each polling station for sorting organic materials from wet waste and dry waste such as plastic, paper, metal, bottles/glass, fabric, rubber/leather, and others; and collecting residual waste into containers;
   5) Pematangsiantar government is not managing the waste sorting results, junk food scraps and leaves are sold to compost companies, and trash such as plastic, paper, metal, sold to the stalls or factories who received recycled material waste;
   6) Waste that cannot be reduced or the resulting residue is managed and disposed of in the landfill;

7) The cost of the initial asset investments made in 2011, assuming the value of depreciation or depreciation of assets as follows:
a) TPS, time use for 20 years.
b) Containers, disposable time for 7 years.
c) Armroll Truck, disposable time for 7 years.
d) The cost of equipment, operating costs and maintenance costs are assumed to rise ± 5% every year.
e) Sales of sorting results (recycled product) are considered no increase each year and are in the same condition with market demand.
f) Analysis of the feasibility took a sample calculation in zone I.

4. Conclusions

4.1. If the waste management is not done, then:
1) The level of existing TPS services averagely decreased 14,99% per year, from 35,24% in 2011 into 19,38% in 2015.
2) The level of existing truck services averagely decreased 22,70% per year, from 74,59% in 2011 into 51,89% in 2015.

4.2. Through a waste management system with gradual sorting at TPS based on priorities per zone per year of service, then:
1) The level of existing TPS service averagely decreased 8,36% per year, from 8,76% in 2011 into 20,05% in 2015.
2) The level of existing truck services averagely increased 18,75% per year, from 97,10% in 2011 into 44,84 in 2015.
3) Can improve service coverage or lowering the rate of decline in existing TPS services by 8,36% per year, which is 27.48% in 2011, 0,88% in 2012, 13,22% in 2013, 0,20% in 2014, and 0,41% in 2015, compared to no waste management.
4) Can improve the existing garbage truck coverage services by 11,42% per year, which is 22,51% in 2011, 21,19% in 2012, 24,20 in 2013, 0,65% in 2014, and 11.43% in 2015, compared to no waste management.

5. References

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Table 1: Piles Measurement

No	Population	Volume (m^3)	Piles (m^3/person/day)	Density (kg/m^3)	Piles (kg/person/day)
1	279.180	543	0,001945	255	0,50
Average			0,001945	255	0,50

Table 2: Projection Level of Waste Services

No	Year	Projection	Growth (%)
1	2011	14,35	4,38
2	2012	18,73	4,38
3	2013	23,1	4,38
4	2014	27,48	4,38
5	2015	31,86	4,38

Table 3: Level of Existing TPS Services

No	Year	Projection (m^3/day)	Total Load (m^3)	Service Level (%)
1	2011	434,35	121	35,24
2	2012	478	121	25,31
3	2013	523	121	23,14
4	2014	543	121	22,28
5	2015	624,45	121	19,38

Table 4: Level of Existing Truck Services

No	Year	Projection (m³/day)	Capacity (m³/day)	Service Level (%)
1	2011	434,35	324	74,59
2	2012	478	324	67,78
3	2013	523	324	61,95
4	2014	543	324	59,67
5	2015	624,45	324	51,89

Table 5: Level of Waste Management Services based on the Zone with Sorting method in TPS

No	Service Zone	Year				
		2011	2012	2013	2014	2015
1	Zone I Siantar West					
	Piles (m³/day)	178,21	205,42	206,77	209,22	268,31
	Service Level (%)	21,36	21,36	21,36	21,36	21,36
	Piles management (m³/day)	38,07	43,88	44,17	44,69	57,32
	Piles Management Level (%)	15,42	15,42	15,42	15,42	15,42
	Reduction (%)	80,73	80,73	80,73	80,73	80,73
	Piles reduction (m³/day)	30,73	35,42	35,66	36,08	46,27
	Residual (m³/day)	7,34	8,46	8,51	8,61	11,05
2	Zone II North Siantar	162,62	200,81	201,43	211,1	218,47
	Piles (m³/day)	21,36	21,36	21,36	21,36	21,36
	Service Level (%)	34,74	42,89	43,03	45,09	46,67
	Piles management (m³/day)	15,41	15,41	15,41	15,41	15,41
	Piles Management Level (%)	80,73	80,73	80,73	80,73	80,73
	Reduction (%)	28,05	34,63	34,74	36,4	37,68
	Piles reduction (m³/day)	6,69	8,26	8,29	8,69	8,99
	Residual (m³/day)	90,14	92,88	93,01	93,26	94,32
3	Zone III East Siantar	21,36	21,36	21,36	21,36	21,36
	Piles (m³/day)	19,25	19,84	19,87	19,93	20,15
	Service Level (%)	14,45	14,45	14,45	14,45	14,45
	Piles management (m³/day)	80,73	80,73	80,73	80,73	80,73
	Piles Management Level (%)	15,54	16,02	16,04	16,09	16,27
	Reduction (%)	3,71	3,82	3,83	3,84	3,88
	Piles reduction (m³/day)	40	55,26	55,61	68,16	79,92
	Residual (m³/day)	21,36	21,36	21,36	21,36	21,36
4	Zone IV South Siantar	8,54	11,8	11,89	14,56	17,07
	Piles (m³/day)	13,52	13,52	13,52	13,52	13,52
	Service Level (%)	80,73	80,73	80,73	80,73	80,73
	Piles management (m³/day)	6,89	9,53	9,6	11,75	13,78
	Piles Management Level (%)	1,65	2,27	2,29	2,81	3,29
	Reduction (%)	28,53	33,28	35,63	42,71	61,10
	Piles reduction (m³/day)	21,36	21,36	21,36	21,36	21,36
	Residual (m³/day)	6,09	7,1	7,61	9,12	13,05

5	Zone V Siantar Martoba	13,45	13,45	13,45	13,45	13,45
	Piles (m³/day)	80,73	80,73	80,73	80,73	80,73
	Service Level (%)	4,92	5,73	6,14	7,36	10,53
	Piles management (m³/day)	1,17	1,37	1,47	1,76	2,51
	Piles Management Level (%)	4,12	4,12	4,12	4,12	4,12
	Reduction (%)	80,73	80,73	80,73	80,73	80,73
	Piles reduction (m³/day)	126,94	129,16	131,42	133,72	136,06
	Residual (m³/day)	30,30	30,83	31,37	31,92	32,48

Table 6: Projection of Waste Management based on Service Zone

No	Service Zone	Year				
		2011	2012	2013	2014	2015
1	Zone I Siantar West					
	Piles (m³/day)	178,21	205,42	206,77	209,22	268,31
	Service Level (%)	14,35	18,73	23,10	27,48	31,86
	Piles Management (m³/day)	25,57	38,47	47,76	57,49	85,48
	Piles Management Level (%)	4,95	7,51	8,57	12,36	31,39
2	Zone II North Siantar					
	Piles (m³/day)	162,62	200,81	201,43	211,10	218,47
	Service Level (%)	14,35	18,73	23,10	27,48	31,86
	Piles management (m³/day)	23,33	37,61	46,53	58,01	69,60
	Piles Management Level (%)	4,05	7,23	8,19	9,53	10,46
3	Zone III East Siantar					
	Piles (m³/day)	90,14	92,88	93,01	93,26	94,32
	Service Level (%)	14,35	18,73	23,10	27,48	31,86
	Piles management (m³/day)	12,93	17,40	21,49	25,63	30,05
	Piles Management Level (%)	4,24	6,08	9,06	14,30	17,71
4	Zone IV South Siantar					
	Piles (m³/day)	40,00	55,26	55,61	68,16	79,92
	Service Level (%)	14,35	18,73	23,10	27,48	31,86
	Piles management (m³/day)	5,74	10,34	12,84	18,73	25,46
	Piles Management Level (%)	2,75	2,29	3,09	2,81	2,66
5	Zone V Siantar Martoba					
	Piles (m³/day)	28,53	33,28	35,69	42,71	61,10
	Service Level (%)	14,35	18,73	23,10	27,48	31,86
	Piles management (m³/day)	4,09	6,23	8,24	1,17	1,95
	Piles Management Level (%)	1,43	6,05	6,12	3,87	2,20
		1,43	6,05	6,12	3,87	2,20

Table 7: Level of Waste Management with Sorting method in TPS

No	Service Zone	Year

		2011	2012	2013	2014	2015
1	Zone I					
	Sorting	15,63	15,63	15,63	15,63	15,63
	Zone II, III, IV and V					
	Projection of Service Level	11,21	14,40	17,60	20,79	23,98
	Service Level	26,83	30,02	33,22	36,41	39,61
2	Zone I and III					
	Sorting		29,54	29,54	29,54	29,54
	Zone II, IV and V					
	Projection of Service Level		9,38	11,47	13,55	15,63
	Service Level		38,92	41,01	43,09	45,17
3	Zone I, II, and III					
	Sorting			43,93	43,93	43,93
	Zone IV and V					
	Projection of Service Level			5,13	6,06	6,99
	Service Level			49,06	49,99	50,92
4	Zone I, II, III, and IV					
	Sorting				51,45	51,45
	Zone II, III, IV and V					
	Projection of Service Level				2,14	2,47
	Service Level				53,59	53,92
5	Zone I, II, III, IV and V					
	Sorting					55,57
	Service Level					55,57

Table 8: Level of Existing TPS Service with Sorting method in TPS

No	Service Zone	Year				
		2011	2012	2013	2014	2015
1	Zone I					
	Sorting	38,07	43,88	44,17	44,69	57,32
	Zone II, III, IV and V					
	Projection of Service Level	333,68	402,81	373,04	367,81	526,16
	Service Level	8,76	9,18	8,45	8,23	9,18
2	Zone I and III					
	Sorting		298,30	299,78	302,48	362,63
	Zone II, IV and V					
	Projection of Service Level		13,60	13,46	13,22	9,20
	Service Level		40,56	40,36	40,00	33,37
3	Zone I, II, and III					
	Sorting			501,21	513,58	580,79
	Zone IV and V					
	Projection of Service Level			4,82	4,59	3,59
	Service Level			24,14	23,56	20,83
4	Zone I, II, III, and IV					
	Sorting				581,74	661,02
	Zone II, III, IV and V					

	Projection of Service Level				3,58	2,77
	Service Level				20,80	18,31
5	Zone I, II, III, IV and V					
	Sorting					603,48
	Service Level					20,05
						44,87

Table 9: Level of Existing Trucks Services with Sorting method in TPS

No	Service Zone	Year				
		2011	2012	2013	2014	2015
1	Zone I					
	Sorting	499,50	587,65	592,51	624,45	722,12
	Zone II, III, IV and V					
	Projection of Service Level	333,68	402,81	373,04	367,81	526,16
	Service Level	97,10	80,43	86,85	88,09	61,58
2	Zone I and III					
	Sorting		298,30	299,78	302,48	362,63
	Zone II, IV and V					
	Projection of Service Level		110,05	136,86	161,03	212,54
	Service Level		33,97	42,24	49,70	65,60
3	Zone I, II, and III					
	Sorting			501,21	513,58	581,10
	Zone IV and V					
	Projection of Service Level			91,24	110,87	141,02
	Service Level			18,20	21,59	24,27
4	Zone I, II, III, and IV					
	Sorting				581,74	661,02
	Zone II, III, IV and V					
	Projection of Service Level				42,71	61,10
	Service Level				98,40	70,34
5	Zone I, II, III, IV and V					
	Sorting					722,12
	Total of Residual and Piles Management					722,12
	Trucks Service Level (%)					44,87

Table 10: Waste Service Improvement with Sorting method in TPS

No	Service Zone	Year				
		2011	2012	2013	2014	2015
1	Zone I					
	Sorting	22,64	23,17	29,10	41,21	53,73
	Projection of Service Level	14,35	18,73	23,10	27,48	31,86
	Service Improvement	8,29	4,44	6,00	13,73	21,87
2	Zone I, and III					
	Sorting		38,92	41,01	43,09	45,17
	Projection of Service Level		18,73	23,10	27,48	31,86

	Service Improvement		20,19	17,91	15,61	13,31
3	Zone I, II, and III					
	Sorting			16,13	15,86	14,94
	Projection of Service Level			23,10	27,48	31,86
	Service Improvement			-6.97	-11.62	-16.92
4	Zone I, II, III, and IV					
	Sorting				18,98	17,88
	Projection of Service Level				27,48	31,86
	Service Improvement				-8.50	-13.98
5	Zone I, II, III, IV and V					
	Sorting					21,36
	Projection of Service Level					31,86
	Service Improvement					-10.50

Table 11: Existing TPS Service Improvement with Sorting method in TPS

No	Service Zone	Year				
		2011	2012	2013	2014	2015
1	Zone I					
	Sorting	8,76	9,18	8,45	8,23	9,18
	Projection of Service Level	35,24	25,31	24,14	22,28	19,38
	Service Improvement	-26.48	-16.13	15.69	-14.05	-10.20
2	Zone I, and III					
	Sorting		40,56	40,36	40,00	33,37
	Projection of Service Level		25,31	24,14	22,28	19,38
	Service Improvement		15,25	16,22	17,72	13,99
3	Zone I, II, and III					
	Sorting			21,14	23,56	20,83
	Projection of Service Level			24,14	22,28	19,38
	Service Improvement			-3.00	1,28	1,45
4	Zone I, II, III, and IV					
	Sorting				20,80	18,30
	Projection of Service Level				22,28	19,38
	Service Improvement				-1.48	-1.08
5	Zone I, II, III, IV and V					
	Sorting					20,05
	Projection of Service Level					19,38
	Service Improvement					0,67

Table 12: Existing Trucks Service Improvement With Sorting method in TPS

No	Service Zone	Year				
		2011	2012	2013	2014	2015
1	Zone I					
	Sorting	97,10	80,40	86,85	88,09	61,58
	Projection of Service Level	74,59	67,78	61,95	59,67	51,89
	Service Improvement	22,51	12,62	24,90	28,42	9,69
2	Zone I and III					

	Sorting			33,97	42,40	49,70	65,60
	Projection of Service Level			67,78	61,95	59,67	51,89
	Service Improvement			-33.81	-19.55	-9.97	13,71
3	Zone I, II, and III						
	Sorting				18,20	21,59	24,27
	Projection of Service Level				61,95	59,67	51,89
	Service Improvement				43.75	-38.08	-27.62
4	Zone I, II, III, and IV						
	Sorting					98,40	70,34
	Projection of Service Level					59,67	51,89
	Service Improvement					38,73	18,45
5	Zone I, II, III, IV and V						
	Sorting						44,87
	Projection of Service Level						51,89
	Service Improvement						-7.02

Figure 1 Potential and Problems of Waste

Figure 2. Map of the City Administration Pematangsiantar

Figure 3 Figure rubbish in TPS Location

Figure 4 Sample Image Trash housing complex

Figure 5 Sample Image Trash location Parluasan market Pematangsiantar

Figure 6 Sample Image Trash location Horas market Pematangsiantar